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STATE OF ALASKA

William A. Egan, Governor

# ANNUAL REPORT OF PROGRESS, 1963 - 1964

# FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-5

# SPORT FISH INVESTIGATIONS OF ALASKA

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# INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska Federal Aid in Fish Restoration Project F-5-R-5, "Sport Fish Investigations of Alaska."

The project is composed of 25 separate studies designed to evaluate the various aspects of the State's recreational fishery resources. Of these, eight jobs are designed to continue the cataloging and inventory of the numerous State waters in an attempt to prepare an index of the recreational waters. Four jobs are designed for specific sport fishery creel census while the remainder of the jobs are more specific in nature. These include independent studies on king salmon, silver salmon, grayling, Dolly Varden, a statewide access evaluation program, egg take program and a residual toxaphene study. The information gathered from the combined studies will provide the necessary background data for a better understanding of local management problems and assist in the development of future investigational studies.

The subject matter contained within these reports is often fragmentary in nature. The findings may not be conclusive and the interpretations contained therein are subject to re-evaluation as the work progresses.

Volume 5 Report No. 8-C-2

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

State of: ALASKA Name: Sport Fish Investigations of Alaska.

Project No: F-5-R-5 Title: Mirror Lake Aeration Study

Job No: 8-C-2

Period Covered: October 1, 1963 to May 14, 1964.

Abstract:

The aeration equipment was not utilized because dissolved oxygen concentrations were above 5 ppm during the study period. Mean concentration of dissolved oxygen during the report period was 7.7 ppm. Highest concentrations of carbon dioxide were 8 ppm. The maximum ice depth recorded was 37 inches on March 26. The deepest snow depth recorded on Mirror Lake for any one period was 12 inches with a mean depth of 8 inches.

Recommendations:

It is recommended that this project be discontinued. During the course of study, dissolved oxygen concentrations did not drop below the minimum required for fish survival and observations of winter-killed fish were negligible.

Objectives:

To measure the effectiveness of mechanical aeration in Mirror Lake.

Techniques Used:

A description of Mirror Lake, the aeration system and the water sample stations is presented in the Dingell-Johnson Progress F-5-R-3 (ADFG, 1961) and F-5-R-4 (ADFG 1962) Mirror Lake completion reports.

The 250 feet of nonperforated and 1,000 feet of perforated weighted plastic hose installed at the bottom of Mirror Lake in December, 1962, remained in position in the lake throughout the summer of 1963.

Water samples were collected periodically from seven stations on Mirror Lake from December 1963 through May 1964 by a Kemmerer sampler (Figure 1, ADFG 1962). A Hach DR colorimeter was utilized to analyze the water for dissolved oxygen, hydrogen-ion (pH) and turbidity, while carbon dioxide and total alkalinity concentrations were computed by the titrimetric method. Snow cover, ice thickness, and water and air temperatures were recorded simultaneously in each sample period. A pocket thermometer was used to read the temperatures.

Stream flow measurements were made periodically at the inlet and outlet streams of Mirror Lake by the Embody method.

A wire screen was bolted over the outlet culvert to prevent fish from migrating out of the lake.

Findings:

On December 13, 1962, the weighted, plastic air hose was installed through the ice in a rectangular grid on the bottom of Mirror Lake. Because of the difficulty in removing and installing the hose, it was left submerged in position in Mirror Lake during the summer of 1963. An air compressor was to be installed and utilized when the dissolved oxygen concentrations dropped at all stations below 5 ppm. However, on only three occasions at one station a reading of less than 5 ppm was recorded; therefore, the compressor was not operated.

Beginning December 16, 1963, up until May 14, 1964, water samples were collected bi-monthly from five stations and at the outlet and inlet previously described in F-5-R-3 (ADFG 1961) Mirror Lake completion report.

The dissolved oxygen concentration peaked between December 31 and January 8. The highest dissolved oxygen concentration for this period was recorded on January 8 at the surface with 10.5 ppm at station 3. A low of 3.8 ppm occurred on April 15 at the surface level at station 3. The differences in dissolved oxygen between the surface and 5 foot depths are presented in TABLES 1 through 5. Mean concentration of dissolved oxygen was about 7.7 ppm in Mirror Lake.

The average carbon dioxide concentration for the 5 stations during the same period was approximately 4 ppm with the highest concentration, 8 ppm, occurring during the

TABLE 1. Dissolved oxygen, pH, temperatures, snow and ice depth, carbon dioxide, total alkalinity and turbidity at Station 1 on Mirror Lake from December 31, 1963 to May 14, 1964

| Date | Depth of Sample | Snow Cover | Ice Cover | Water Temp. | Air Temp. | DO | $CO_2$ | pH | Total Alk. | Turb. |
|---|---|---|---|---|---|---|---|---|---|---|
| December 31, 1963 | 0 | 0" | 25" | 32° F. | 21° F. | 9.2 | 5 ppm | 7.9 | 128 | 0 |
| January 8, 1964 | 0 | 4 | 26 | 32 | 5 | 9.6 | 4 | 7.4 | 135 | 2 |
| January 28, 1964 | 0 | 4 | 29 | 33 | 1 | 10.0 | 4 | 7.3 | 138 | 0 |
| February 14, 1964 | 0 | 8 | 31 | 33 | 3 | 7.3 | 4 | 7.1 | 147 | 3 |
| February 27, 1964 | 0 | 3 | 32 | 34 | 35 | 9.0 | 4 | 7.2 | 140 | 2 |
| March 10, 1964 | 0 | 9 | 33 | 32 | 16 | 8.0 | 4 | 7.2 | 140 | 0 |
| March 26, 1964 | 0 | 5 | 37 | 34 | 43 | 6.0 | 1 | 7.0 | - | 0 |
| April 15, 1964 | 0 | 7 | 36 | 34 | 33 | 6.2 | 4 | 7.0 | 132 | 2 |
| April 30, 1964 | 0 | 1 | 33 | 37 | 48 | 8.5 | 3 | 7.1 | 80 | 5 |
| May 14, 1964 | 0 | 0 | 22 | 41 | 43 | 9.0 | 2 | 7.3 | 78 | 0 |

TABLE 2. Dissolved oxygen, pH, temperatures, snow and ice depth, carbon dioxide, total alkalinity and turbidity at Station on Mirror Lake from December 31, 1963 to May 14, 1964.

| Date | Depth of Sample | Snow Cover | Ice Cover | Water Temp. | Air Temp. | DO | $CO_2$ | pH | Total Alk. | Turb. |
|---|---|---|---|---|---|---|---|---|---|---|
| December 31, 1963 | 0 | 0" | 25" | 32° F. | 21° F. | 8.6 | 4 | 7.8 | 128 | 3 |
| | 5 | 0 | 25 | 35 | 21 | 8.5 | 3 | 7.7 | 127 | 3 |
| January 8, 1964 | 0 | 4 | 26 | 33 | 5 | 9.7 | 4 | 7.4 | 132 | 0 |
| | 5 | 4 | 26 | 34 | 5 | 9.0 | 5 | - | 135 | 1 |
| January 28, 1964 | 0 | 4 | 28 | 33 | 1 | 8.0 | 6 | 7.0 | 139 | 0 |
| | 5 | 4 | 28 | 35 | 1 | 7.8 | 4 | 7.2 | 141 | 0 |
| February 14, 1964 | 0 | 8 | 31 | 33 | 3 | 7.3 | 4 | 7.1 | 147 | 3 |
| | 5 | 8 | 31 | - | - | - | - | - | - | - |
| February 27, 1964 | 0 | 3 | 30 | 33 | 35 | 9.7 | 4 | 7.2 | 140 | 0 |
| | 5 | 3 | 30 | 36 | 35 | 7.5 | 4 | 7.1 | 141 | 3 |
| March 10, 1064 | 0 | 9 | 31 | 33 | 16 | 9.1 | 3 | 7.3 | 121 | 0 |
| | 5 | 9 | 31 | 33 | 16 | 8.1 | 3 | 7.3 | 120 | 0 |
| March 26, 1964 | 0 | 12 | 33 | 35 | 43 | 6.0 | 6 | 6.9 | - | 0 |
| | 5 | 12 | 33 | 35 | 43 | - | - | - | - | - |
| April 15, 1964 | 0 | 7 | 33 | 34 | 33 | 8.3 | 3 | 7.2 | 102 | 2 |
| | 5 | 7 | 36 | - | - | - | - | - | - | - |
| April 30, 1964 | 0 | 1 | 33 | 38 | 48 | - | - | - | - | - |
| | 5 | 1 | 33 | - | - | - | - | - | - | - |
| May 14, 1964 | 0 | 0 | 22 | 40 | 43 | 8.6 | 2 | 7.2 | 63 | 2 |
| | 5 | 0 | 22 | - | - | - | - | - | - | - |

TABLE 3. Dissolved oxygen, pH, temperatures, snow and ice depth, carbon dioxide, total alkalinity and turbidity at Station 3 on Mirror Lake from December 31, 1963 to May 14, 1964

| Date | Depth of Sample | Snow Cover | Ice Cover | Water Temp. | Air Temp. | DO | $CO_2$ | pH | Total Alk. | Turb. |
|---|---|---|---|---|---|---|---|---|---|---|
| December 31, 1963 | 0 | 0" | 25" | 32° F. | 21° F. | 9.6 | 4 | 7.7 | 125 | 0 |
| | 5 | 0 | 25 | 37 | 21 | 9.1 | 5 | 7.6 | 126 | 2 |
| January 8, 1964 | 0 | 4 | 26 | 32 | 3 | 10.5 | 5 | 7.3 | 129 | 3 |
| | 5 | 4 | 26 | 37 | 3 | 8.8 | 5 | 7.3 | 130 | 2 |
| January 28, 1964 | 0 | 4 | 28 | 33 | 9 | 9.0 | 3 | 7.1 | 135 | 3 |
| | 5 | 4 | 28 | 36 | 9 | 7.5 | 5 | 7.2 | 134 | 0 |
| February 14, 1964 | 0 | 8 | 30 | 34 | 8 | 7.8 | 4 | 7.1 | 148 | 2 |
| | 5 | 8 | 30 | 35 | 8 | 7.6 | 4 | 7.2 | 146 | 0 |
| February 27, 1964 | 0 | 3 | 31 | 33 | 36 | 7.1 | 4 | 7.2 | 136 | 0 |
| | 5 | 3 | 31 | 36 | 36 | 5.6 | 4 | 7.1 | 144 | 2 |
| March 10, 1964 | 0 | 9 | 33 | 34 | 18 | 5.8 | 4 | 7.1 | 138 | 0 |
| | 5 | 9 | 33 | 34 | 18 | 4.8 | 5 | 7.1 | 145 | 0 |
| March 26, 1964 | 0 | 10 | 33 | 34 | 43 | 5.8 | 7 | 7.0 | - | 0 |
| | 5 | 10 | 33 | 34 | 43 | - | - | - | - | - |
| April 15, 1964 | 0 | 7 | 36 | 34 | 36 | 3.8 | 5 | 6.9 | 130 | 10 |
| | 5 | 7 | 36 | 36 | 36 | 4.4 | 5 | 7.0 | 141 | 5 |
| April 30, 1964 | 0 | 1 | 32 | 35 | 48 | 7.1 | 3 | 6.9 | 72 | 40 |
| | 5 | 1 | 32 | 38 | 48 | - | - | - | - | - |
| May 14, 1964 | 0 | 0 | 21 | 38 | 41 | 6.5 | 1 | 7.0 | 33 | 2 |
| | 5 | 0 | 21 | 44 | 41 | 9.1 | 3 | 7.5 | 112 | 12 |

TABLE 4. Dissolved oxygen, pH, termperatures, snow and ice depth, carbon dioxide, total alkalinity and turbidity at Station 4 on Mirror Lake from December 31, 1963 to May 14, 1964

| Date | Depth of Sample | Snow Cover | Ice Cover | Water Temp. | Air Temp. | DO | $CO_2$ | pH | Total Alk. | Turb. |
|---|---|---|---|---|---|---|---|---|---|---|
| December 31, 1963 | 0 | 0" | 25" | 25° F. | 34° F. | 8.5 | 5 | 7.7 | 117 | 3 |
| | 5 | 0 | 25 | 38 | 21 | 8.2 | 4 | 7.8 | 136 | 3 |
| January 8, 1964 | 0 | 4 | 26 | 33 | 2 | 8.7 | 4 | 7.3 | 133 | 2 |
| | 5 | 4 | 26 | 37 | 2 | 9.8 | 4 | 7.4 | 130 | 0 |
| January 28, 1964 | 0 | 4 | 29 | 33 | 12 | 8.5 | 4 | 7.3 | 136 | 5 |
| | 5 | 4 | 29 | 36 | 12 | 8.3 | 4 | 7.2 | 138 | 0 |
| February 14, 1964 | 0 | 8 | 31 | 33 | 7 | 6.8 | 4 | 7.1 | 149 | 0 |
| | 5 | 8 | 31 | 35 | 7 | 6.4 | 5 | 7.1 | 147 | 0 |
| February 27, 1964 | 0 | 3 | 32 | 34 | 36 | 6.3 | 5 | 7.2 | 146 | 3 |
| | 5 | 3 | 32 | 36 | 36 | 6.0 | 4 | 7.1 | 140 | 3 |
| March 10, 1964 | 0 | 9 | 33 | 34 | 18 | 6.6 | 4 | 7.2 | 147 | 0 |
| | 5 | 9 | 33 | 35 | 18 | 6.0 | 5 | 7.1 | 152 | 0 |
| March 26, 1964 | 0 | 9 | 33 | 35 | 43 | 5.5 | 8 | 7.0 | - | 0 |
| | 5 | 9 | 33 | 35 | 43 | - | - | - | - | - |
| April 15, 1964 | 0 | 7 | 36 | 34 | 34 | 6.7 | 4 | 7.1 | 141 | 5 |
| | 5 | 7 | 36 | 35 | 34 | 5.1 | 5 | 7.0 | 142 | 3 |
| April 30, 1964 | 0 | 1 | 34 | 36 | 48 | 6.3 | 4 | 7.1 | 132 | 0 |
| | 5 | 1 | 34 | 39 | 48 | 5.5 | 6 | 7.1 | 148 | 0 |
| May 14, 1964 | 0 | 0 | 24 | 40 | 44 | 8.9 | 2 | 7.3 | 73 | 0 |
| | 5 | 0 | 24 | 43 | 44 | 10.0 | 2 | 7.4 | 95 | 0 |

TABLE 5. Dissolved oxygen, pH, temperatures, snow and ice depth, carbon dioxide, total alkalinity and turbidity at Station 5 on Mirror Lake from December 31, 1964 to May 14, 1964

| Date | Depth of Sample | Snow Cover | Ice Cover | Water Temp. | Air Temp. | DO | $CO_2$ | pH | Total Alk. | Turb. |
|---|---|---|---|---|---|---|---|---|---|---|
| December 31, 1963 | 0 | 0" | 25" | 35° F. | 21° F. | 8.4 | 3 | 7.8 | 135 | 2 |
| January 8, 1964 | 0 | 4 | 26 | 32 | 2 | 9.9 | 4 | 7.4 | 134 | 0 |
| January 28, 1964 | 0 | 4 | 29 | 33 | 10 | 8.9 | 4 | 7.3 | 139 | 2 |
| February 14, 1964 | 0 | 8 | 31 | 33 | 7 | 7.2 | 5 | 7.1 | 146 | 3 |
| February 27, 1964 | 0 | 3 | 32 | 33 | 37 | 6.4 | 4 | 7.2 | 147 | 5 |
| March 10, 1964 | 0 | 9 | 33 | 33 | 29 | 5.7 | 6 | 7.1 | 153 | 3 |
| March 26, 1964 | 0 | 6 | 34 | 34 | 43 | 5.5 | 7 | 7.0 | - | 0 |
| April 15, 1964 | 0 | 7 | 36 | 34 | 35 | 6.7 | 4 | 7.1 | 122 | 0 |
| April 30, 1964 | 0 | 1 | 34 | 37 | 49 | 7.0 | 4 | 7.2 | 114 | 0 |
| May 14, 1964 | 0 | 0 | 21 | 40 | 45 | 9.2 | 2 | 7.3 | 74 | 3 |

latter part of March at station 4. A low of 1 ppm occurred at stations 1 and 3 on March 26 and May 14, respectively. TABLES 1 through 5 show the difference in carbon dioxide levels at the surface and 5 foot levels.

Mean concentration of total alkalinity for the 5 stations on Mirror Lake was about 146 ppm on February 14 with a low of 75 ppm on May 14.

The range in pH concentration was a high of 7.9 occurring during the latter part of December and a low of 6.9 in late March. The pH fluctuations between the surface and 5-foot depths were very slight (TABLES 1 through 5).

Ice began forming on the lake during early October and by October 24, the lake was completely frozen over. On December 16 the ice depth was 21 inches and by January 1 had attained a depth of 25 inches. The mean ice depth during the winter was 29 inches, with the maximum depth of 37 inches recorded on March 26. In early May the ice cover on the lake was observed to be getting "rotten" and on May 14 the final samples were taken.

Deepest snow depth recorded on the lake was 12 inches on March 26 with a mean depth of 8 inches. Mean depth of snow during the winter period was 5.5 inches.

The surface water temperatures fluctuated between 33° F. and 35° F. at station 4 with an average of 33.7° F. In the latter part of April the temperatures began rising slightly. During the winter, at the 5-foot depths, the water temperatures fluctuated from 35° F. to 38° F. On April 30 the temperature rose to 39° F. and by May 14 had increased to 43° F. The mean temperatures at the 5-foot depth during the winter was 37° F. The greatest temperature differential, occurring from December 16 to May 14 between the surface and 5-foot depths, was 5° F. with an average differential of 2° F.

Spring turnover occurred between April 30 and May 14.

Air temperatures are presented for this period of study in TABLE 6.

Inlet Stream to Mirror Lake

Description of the inlet stream is presented in F-5-R-3 (ADFG 1962) completion report.

TABLE 6. Some physical characteristics of Mirror Lake during the winter 1963 - 1964

| Date | Snow Depth | Ice Depth | Air Temp. | Water Temp. Surface Station 4 | Water Temp. 5 ft. depth Station 4 | Water Temp. Difference |
|---|---|---|---|---|---|---|
| December 31, 1963 | 0" | 25" | 21° F. | 34° F. | 38° F. | + 4 |
| January 8, 1964 | 4.0 | 26 | 2 | 33 | 37 | + 4 |
| January 28, 1964 | 4.0 | 29 | 12 | 33 | 36 | + 3 |
| February 14, 1964 | 8.0 | 31 | 7 | 33 | 35 | + 2 |
| February 27, 1964 | 3.0 | 32 | 36 | 34 | 36 | + 2 |
| March 10, 1964 | 9.0 | 33 | 18 | 34 | 35 | + 1 |
| March 26, 1964 | 9.0 | 33 | 43 | 35 | 35 | 0 |
| April 15, 1964 | 7.0 | 36 | 34 | 34 | 35 | + 1 |
| April 30, 1964 | 1.0 | 34 | 48 | 36 | 39 | + 3 |
| May 14, 1964 | 0 | 24 | 44 | 40 | 43 | + 3 |

The average water temperature was 36° F., but varied from 34° F. to 40° F. (TABLE 7). Stream flows ranged from 0.12 to 0.33 cfs.

Chemical characteristics of the water are as follows: A high concentration of dissolved oxygen existed throughout the winter months ranging from 9.6 to 11.8 ppm with a mean of 11.2 ppm. Carbon dioxide fluctuated from 2 to 4 ppm, but maintained a level of about 3 ppm. Concentrations of pH varied from 7.8 on December 31 to 7.6 on May 14. Total alkalinity fluctuated from 86 to 94 ppm with the mean being about 90 ppm.

Outlet Stream to Mirror Lake

Description of the outlet stream is presented in F-5-R-4 (ADFG 1962) completion report.

The mean water temperature was 35° F. with a range of 34° F. to 38° F. Stream flows from this lake ranged from .25 cfs to .50 cfs.

Chemical and physical characteristics are presented in TABLE 8. Differences between pH and total alkalinity at the inlet and outlet to Mirror Lake are presented in TABLE 9.

## Literature Cited

Dotson, Phil A.

(1962) Mirror Lake Aeration Study. Alaska Department of Fish and Game, Annual Report of Progress, 1962 - 1963, Vol. 4

Stefanich, Frank A.

(1961) Mirror Lake Aeration Study. Alaska Department of Fish and Game, Annual Report of Progress, 1961 - 1962, Vol. 3

TABLE 7. Chemical and pnysical characteristics of the inlet stream to Mirror Lake from December 31, 1963 to May 14, 1964

| Date | Water Temp. | Air Temp. | DO | $CO_2$ | pH | Alkalinity | Turbidity |
|---|---|---|---|---|---|---|---|
| December 31, 1963 | 35° F. | 21° F. | 9.6 | 3 | 7.8 | 92 | 2 |
| January 8, 1964 | 34 | 5 | 11.2 | 2 | 7.5 | 86 | 5 |
| January 28, 1964 | 35 | 0 | 11.2 | 3 | 7.4 | 92 | 0 |
| February 14, 1964 | 35 | 5 | 11.4 | 3 | 7.5 | 90 | 0 |
| February 27, 1964 | 35 | 35 | 11.8 | 2 | 7.3 | 88 | 0 |
| March 10, 1964 | 35 | 16 | 11.5 | 2 | 7.6 | 87 | 0 |
| April 15, 1964 | 37 | 35 | 11.7 | 3 | 7.5 | 86 | 0 |
| April 30, 1964 | 37 | 48 | 11.5 | 4 | 7.4 | 92 | 0 |
| May 14, 1964 | 40 | 44 | 11.2 | 2 | 7.6 | 94 | 0 |

TABLE 8. Chemical and physical characteristics of the outlet stream to Mirror Lake from December 31, 1963 to May 14, 1964

| Date | Water Temp. | Air Temp. | DO | $CO_2$ | pH | Alkalinity | Turbidity |
|---|---|---|---|---|---|---|---|
| December 31, 1963 | 34° F. | 21° F. | 9.4 | 4 | 7.8 | 128 | 0 |
| January 8, 1964 | 34 | 2 | 9.9 | 5 | 7.4 | 132 | 2 |
| January 28, 1964 | 34 | 10 | 9.1 | 4 | 7.3 | 140 | 0 |
| February 14, 1964 | 34 | 7 | 7.3 | 4 | 7.1 | 150 | 2 |
| February 27, 1964 | 34 | 37 | 6.5 | 5 | 7.1 | 148 | 3 |
| March 10, 1964 | 35 | 20 | 5.9 | 5 | 7.1 | 148 | 0 |
| April 15, 1964 | 33 | 34 | 5.6 | 5 | 7.0 | 154 | 3 |
| April 30, 1964 | 37 | 49 | 7.0 | 3 | 6.6 | 47 | 25 |
| May 14, 1964 | 38 | 45 | 7.0 | 1 | 6.9 | 29 | 0 |

TABLE 9. Differentials between pH and total alkalinity at the inlet and outlet to Mirror Lake from December 31, 1963 to May 14, 1964

| Date | Inlet pH | Outlet pH | Diff. | Inlet Total Alk. | Outlet Total Alk. | Diff. |
|---|---|---|---|---|---|---|
| December 31, 1963 | 7.8 | 7.8 | 0 | 92 ppm | 128 ppm | + 36 |
| January 8, 1964 | 7.5 | 7.4 | -0.1 | 86 ppm | 132 ppm | + 46 |
| January 28, 1964 | 7.4 | 7.3 | -0.1 | 92 ppm | 140 ppm | + 48 |
| February 14, 1964 | 7.5 | 7.1 | -0.4 | 90 ppm | 150 ppm | + 60 |
| February 27, 1964 | 7.3 | 7.1 | -0.2 | 88 ppm | 148 ppm | + 60 |
| March 10, 1964 | 7.6 | 7.1 | -0.5 | 87 ppm | 148 ppm | + 61 |
| April 15, 1964 | 7.5 | 7.0 | -0.5 | 86 ppm | 154 ppm | + 68 |
| April 30, 1964 | 7.4 | 6.6 | -0.8 | 92 ppm | 47 ppm | - 45 |
| May 14, 1964 | 7.6 | 6.9 | -0.7 | 94 ppm | 29 ppm | - 65 |

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